

**WHAT IS CLAIMED IS:**

- 1 1. For use with a node, a method comprising:
  - 2 a) accepting status information from at least two protocols;
  - 3 b) composing a message including the status information; and
  - 4 c) sending the message towards a neighbor node.
- 1 2. The method of claim 1 further comprising:
  - 2 d) maintaining a first timer for tracking a send time interval, wherein the
  - 3 acts of composing a message and sending the message are performed
  - 4 after expiration of the first timer; and
  - 5 e) restarting the first timer after the message is sent.
- 1 3. The method of claim 2 wherein the message further includes a dead time
- 2 interval, and wherein the send time interval is less than the dead time interval.
- 1 4. The method of claim 2 wherein the message further includes a dead time
- 2 interval, and wherein the send time interval is no more than one third of the dead
- 3 time interval.
- 1 5. The method of claim 2 wherein the send time interval is less than one second.
- 1 6. The method of claim 2 wherein the send time interval is less than 100 msec.
- 1 7. The method of claim 1 wherein the message further includes a dead time
- 2 interval.
- 1 8. The method of claim 1 wherein the act of sending the message includes
- 2 providing the message in an Internet protocol packet.

- 1        9. The method of claim 8 wherein the act of sending the message towards the
- 2        neighbor node includes setting a destination address in the Internet protocol
- 3        packet to a multicast address associated with routers that support aggregated
- 4        protocol liveness.
- 1        10. The method of claim 1 wherein the neighbor node has at least one protocol
- 2        peering with at least one of the at least two protocols.
- 1        11. The method of claim 1 wherein the status information includes a protocol
- 2        state selected from a group of protocols states consisting of (A) protocol up, (B)
- 3        protocol down, (C) protocol not reporting, and (D) protocol restarting.
- 1        12. For use with a node, a method comprising:
  - 2        a) receiving a message including
    - 3        i) for a first set of at least two protocols of a neighbor node, status
    - 4        information for each of the protocols of the first set, and
    - 5        ii) a time interval; and
  - 6        b) updating neighbor node protocol status information using the message.
- 1        13. The method of claim 12 wherein the act of updating neighbor node protocol
- 2        status information includes
  - 3        i) setting a first timer to the time interval and starting the first timer,
  - 4        ii) if the first timer expires, setting the status of each of the
  - 5        protocols of the neighbor node to down, and
  - 6        iii) if a further message, sourced from the neighbor node, and
  - 7        including
    - 8        A) for a second set of at least two protocols, status
    - 9        information for each of the protocols of the second set, and
    - 10        B) a new time interval,
  - 11        is received then, resetting the first timer to the new time interval and
  - 12        restarting the first timer.

- 1    14. The method of claim 13 wherein each of the time interval and the new time
- 2    interval is less than one second.
  
- 1    15. The method of claim 12 wherein the status information includes a protocol
- 2    state selected from a group of protocols states consisting of (A) protocol up, (B)
- 3    protocol down, (C) protocol not reporting, and (D) protocol restarting.
  
- 1    16. The method of claim 13 wherein the act of updating neighbor node protocol
- 2    status information further includes
  - 3       iv) if the further message is received then, in addition to resetting
  - 4       the first timer to the new time interval and restarting the first timer,
  - 5       further
    - 6         A) determining whether the first set of at least two protocols
    - 7         is the same as the second set of at least two protocols,
    - 8         B) if the first set of at least two protocols is determined to be
    - 9         the same as the second set of at least two protocols, then for
    - 10        each of the at least two protocols of both the first and second
    - 11        sets having a changed status, informing a locally running
    - 12        instance of the protocol of the changed status of its peer
    - 13        protocol of the neighbor node, and
    - 14        C) if the first set of at least two protocols is determined to be
    - 15        different from the second set of at least two protocols, then
      - 16         1) for any protocol in the second set but not in the
      - 17         first set, informing a locally running instance of the
      - 18         protocol of the status indicated in the further message
      - 19         of its peer protocol of the neighbor node, and
      - 20         2) for any protocol in the first set but not in the
      - 21         second set, informing a locally running instance of the
      - 22         protocol that the status of its peer protocol of the
      - 23         neighbor node is down.

1       17. The method of claim 16 wherein each of the message and the further  
2       message include an indication of a relative message age, and wherein the act of  
3       updating neighbor node protocol status information includes,

4               iv) if the further message is received then, in addition to resetting  
5               the first timer to the new time interval and restarting the first timer,  
6               further

7                       A) determining whether the further message is younger than  
8                       the message, and  
9                       B) if it is determined that the further message is not younger  
10                      than the message, then discarding the further message.

1       18. The method of claim 13 wherein each of the message and the further  
2       message include an indication of a relative message age, and wherein the act of  
3       updating neighbor node protocol status information includes,

4               iv) if the further message is received then, in addition to resetting  
5               the first timer to the new time interval and restarting the first timer,  
6               further

7                       A) determining whether the further message is younger than  
8                       the message, and  
9                       B) if it is determined that the further message is not younger  
10                      than the message, then discarding the further message.

1       19. A method for monitoring liveness of multiple protocols, the method  
2       comprising:

3               a) determining, at a first node, status information for at least two  
4               protocols;

5               b) sending, from the first node, a message including the determined  
6               status information to a second node;

7               c) receiving, at the second node, the message; and

8               d) updating, by the second node, first node protocol status information  
9               using the message.

- 1 20. The method of claim 19 wherein the message further includes a first time
- 2 interval, and wherein the act of updating neighbor node protocol status
- 3 information includes
  - 4 i) setting a timer to the first time interval;
  - 5 ii) starting the timer;
  - 6 iii) determining whether or not a further message including protocol
  - 7 status information is received from the first node by the second
  - 8 node before the expiration of the timer; and
  - 9 iv) if it is determined that a further message including protocol
  - 10 status information is not received from the first node by the second
  - 11 node before the expiration of the timer, then informing peer
  - 12 protocols of the second node that the at least two protocols of the
  - 13 first node are down.
- 1 21. The method of claim 19 wherein the status information includes a protocol
- 2 state selected from a group of protocols states including at least (A) protocol up,
- 3 (B) protocol down, (C) protocol not reporting, and (D) protocol restarting.
- 1 22. A machine-readable medium having stored thereon a machine readable data
- 2 structure comprising:
  - 3 a) an indication, for at least two protocols of a node, of a state of each of
  - 4 the at least two protocols; and
  - 5 b) a dead interval.
- 1 23. The machine-readable medium of claim 22 wherein the indication indicates a
- 2 protocol state selected from a group of protocols states consisting of (A) protocol
- 3 up, (B) protocol down, (C) protocol not reporting, and (D) protocol restarting.
- 1 24. The machine-readable medium of claim 22 further comprising:
- 2 c) an identifier of the node.

- 1 25. The machine-readable medium of claim 24 wherein the node is a router and
- 2 wherein the identifier is a router identifier.
  
- 1 26. The machine-readable medium of claim 22 further comprising:
  - 2 c) an interface index.
  
- 1 27. For use with a node, elements comprising:
  - 2 a) means for accepting status information from at least two protocols;
  - 3 b) means for composing a message including the status information; and
  - 4 c) means for sending the message towards a neighbor node.
  
- 1 28. The elements of claim 27 further comprising:
  - 2 d) means for maintaining a first timer for tracking a send time interval, wherein the means for composing a message and sending the message compose and send the message after expiration of the first timer; and
  - 3 e) means for restarting the first timer after the message is sent.
  
- 1 29. The elements of claim 28 wherein the message further includes a dead time
- 2 interval, and wherein the send time interval is less than the dead time interval.
  
- 1 30. The elements of claim 28 wherein the message further includes a dead time
- 2 interval, and wherein the send time interval is no more than one third of the dead
- 3 time interval.
  
- 1 31. The elements of claim 28 wherein the send time interval is less than one
- 2 second.
  
- 1 32. The elements of claim 28 wherein the send time interval is less than 100
- 2 msec.

1 33. The elements of claim 27 wherein the message further includes a dead time  
2 interval.

1 34. The elements of claim 27 wherein the means for sending the message  
2 include means for providing the message in an Internet protocol packet.

1 35. The elements of claim 34 wherein the means for sending the message  
2 towards the neighbor node include means for setting a destination address in the  
3 Internet protocol packet to a multicast address associated with routers that  
4 support aggregated protocol liveness.

1 36. The elements of claim 27 wherein the neighbor node has at least one  
2 protocol peering with at least one of the at least two protocols.

1 37. The elements of claim 27 wherein the status information includes a protocol  
2 state selected from a group of protocols states consisting of (A) protocol up, (B)  
3 protocol down, (C) protocol not reporting, and (D) protocol restarting.

1 38. For use with a node, elements comprising:

2 a) an input for receiving a message including  
3 i) for a first set of at least two protocols of a neighbor node, status  
4 information for each of the protocols of the first set, and  
5 ii) a time interval; and  
6 b) means for updating neighbor node protocol status information using  
7 the message.

1 39. The elements of claim 38 wherein the means for updating neighbor node  
2 protocol status information include  
3 i) means for setting a first timer to the time interval and starting the  
4 first timer,

5 ii) means for setting the status of each of the protocols of the  
6 neighbor node to down if the first timer expires, and  
7 iii) means, if a further message, sourced from the neighbor node,  
8 and including  
9 A) for a second set of at least two protocols, status  
10 information for each of the protocols of the second set, and  
11 B) a new time interval,  
12 is received, for resetting the first timer to the new time interval and  
13 restarting the first timer.

1 40. The elements of claim 39 wherein each of the time interval and the new time  
2 interval is less than one second.

1 41. The elements of claim 38 wherein the status information includes a protocol  
2 state selected from a group of protocols states consisting of (A) protocol up, (B)  
3 protocol down, (C) protocol not reporting, and (D) protocol restarting.

1 42. The elements of claim 39 wherein the means for updating neighbor node  
2 protocol status information further include

1 43. The elements of claim 42 wherein each of the message and the further  
2 message include an indication of a relative message age, and wherein the  
3 means for updating neighbor node protocol status information include,  
4 iv) means for  
5 A) determining whether the further message is younger than  
6 the message, and  
7 B) if it is determined that the further message is not younger  
8 than the message, then discarding the further message.  
9 if the further message is received.

1 45. A system comprising:

2 a) a first node adapted to

- 3                   i) determine status information for at least two protocols, and
- 4                   ii) send a message including the determined status information to a
- 5                   second node; and
- 6                   b) the second node adapted to
- 7                   i) receive the message; and
- 8                   ii) update first node protocol status information using the message.

1   46. The system of claim 45 wherein the message further includes a first time  
2   interval, and wherein the act of updating the first node protocol status information  
3   includes

- 4                   A) setting a timer to the first time interval;
- 5                   B) starting the timer;
- 6                   C) determining whether or not a further message including
- 7                   protocol status information is received from the first node by
- 8                   the second node before the expiration of the timer; and
- 9                   D) if it is determined that a further message including
- 10                  protocol status information is not received from the first node
- 11                  by the second node before the expiration of the timer, then
- 12                  informing peer protocols of the second node that the at least
- 13                  two protocols of the first node are down.

1   47. The system of claim 46 wherein the status information includes a protocol  
2   state selected from a group of protocols states including at least (A) protocol up,  
3   (B) protocol down, (C) protocol not reporting, and (D) protocol restarting.